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EAST AFRICAN AGRICULTURAL RESEARCH STATION

AMANI

THIRD ANNUAL REPORT 1930—1931

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EAST AFRICAN AGRICULTURAL RESEARCH STATION, AMANI.

Report for the Period 1st April, 1930, to 31st March, 1931.

STAFF LIST.

Director.—W. Nowell, C.B.E., D.I.C., F.L.S.
Entomologist.—Vacant.
Plant Pathologist.—H. H. Storey, M.A., Ph.D.
Soil Chemist.—G. Milne, M.Sc., F.I.C.
Biochemist.—R. R. Le G. Worsley, A.R.C.S., B.Sc., Ph.D.
Plant Physiologist.—F. J. Nutman, A.R.C.S., M.Sc., D.I.C.
Plant Geneticist.—L. R. Doughty, B.Sc. (Agric.).
Superintendent of Plantations.—F. M. Rogers.
Secretary and Librarian.—R. E. Moreau.
Botanist.—P. J. Greenway, F.L.S.
Assistant Superintendent of Plantations.—K. E. Toms.
Assistant Secretary and Librarian.—W. M. Nutter.
Manager, Kwamkoro Coffee Estate.—E. M. Nicholl.
Engineer-Mechanic.—T. V. Greenwood.
Laboratory Assistant (Pl. Path.).—R. F. W. Nichols.
Laboratory Assistant (Soil Chem.).—W. E. Calton, B.A.
Stenographer.—(Miss) K. Rushworth.

LEAVE MOVEMENTS DURING THE YEAR.

	Departed.	*Returned.*
Mr. K. E. Toms ...	—	12th May, 1930.
Capt. E. M. Nicholl ...	—	31st August, 1930.
Dr. H. H. Storey ...	—	28th September, 1930.
Mr. R. E. Moreau ...	—	29th October, 1930.
Mr. W. Nowell ...	2nd April, 1930.	21st November, 1930.
Miss K. Rushworth ...	14th April, 1930.	26th October, 1930.
Dr. R. R. Worsley ...	6th May, 1930.	26th November, 1930.
Mr. F. M. Rogers ...	29th January, 1931.	—
Mr. G. Milne	18th February, 1931.	—

CHANGES OF STAFF.

Mr. J. I. Bradshaw left on 16th April, 1930, on termination of agreement.

Mr. T. V. Greenwood was appointed Engineer-Mechanic on agreement in his place.

Acting Duties.

Mr. G. Milne acted for the Director from 2nd April to 28th September, 1930, and Dr. H. H. Storey from 28th September to 21st November, 1930.

Mr. W. Nutter acted for the Secretary and Mr. R. F. W. Nichols for the Librarian from 20th March to 29th October, 1930.

Mr. K. E. Toms acted for the Superintendent from 29th January, 1931, to the end of the year.

REPORT OF THE DIRECTOR.

During the year under review the research work of the Station made steady progress on the lines described in previous reports, save for the unavoidable interruptions caused in certain sections by the absence of officers on leave. In the sections of Plant Pathology and Soil Science the employment of European laboratory assistants enables routine work to be continued; in the other sections the leave of the officer in charge involves the complete closing down of work for a period of seven or eight months. This is an obviously uneconomical arrangement, since the general overhead charges are not appreciably reduced, and it is hoped that provision will eventually be made for junior assistants to be appointed.

The post of Entomologist remained vacant throughout the year but an appointment has been made and Mr. T. W. Kirkpatrick will take up the post in August, 1931. Mr. Kirkpatrick has previous service in Egypt, Kenya, and the Sudan.

The general equipment of the Station was completed during the year by the provision of a continuous and ample supply of electric current generated on the Sigi River. The anticipated improvement in communications through the re-opening of the branch railway to Sigi did not take place. There is, however, a prospect that the adoption of a section of the railway alignment will enable the main difficulties of the present road to be avoided.

In accordance with paragraph 15 of the Report of the Amani Conference a statement of the finances of the Research Station is given at the end of this report. (Appendix.)

RESEARCH PROGRAMME.

The principal administrative events of the year have been connected with the reconsideration of the Research Programme. When the Station was reorganized in 1927 there was no advisory body connected with the Colonial Office to which the Director's suggestions could be submitted for criticism or confirmation. An *ad hoc* Committee was formed for the purpose and held a single meeting at which the draft programme was confirmed. The appointment of the Colonial Advisory Council of Agriculture and Animal Health in 1929 provided a more permanent organization

and at its Fourth Meeting on 27th February, 1930, the following Sub-Committee was appointed to reconsider the Amani programme in consultation with the Director during his presence in England on leave :—

Mr. F. A. Stockdale, C.B.E., Agricultural Advisor to the Secretary of State for the Colonies, (Chairman).
Major Walter Elliot, M.C., M.P., Research Committee, Empire Marketing Board.
Sir Guy Marshall, C.M.G., D.Sc., F.R.S., Director, Imperial Institute of Entomology.
Dr. E. J. Butler, C.I.E., F.R.S., Director, Imperial Institute of Mycology.
Sir John Russell, D.Sc., F.R.S., Director, Rothamsted Agricultural Experimental Station.

The Sub-Committee's report was approved by the Council at its Sixth Meeting on 19th September, 1930.

In order to give an opportunity for local opinion to be expressed, this report was referred by the Secretary of State for the Colonies to a special conference of the Directors of Agriculture of the East African Dependencies held at Amani from the 2nd to the 6th of February, 1931. The Colonial Office was represented by Mr. F. A. Stockdale, who presided over the meetings, and Mr. Seel. Kenya, Uganda, Tanganyika Territory, and Zanzibar were represented by their Directors of Agriculture, and Nyasaland by the Entomologist. Northern Rhodesia was not represented. Sir Arthur W. Hill, Director of the Royal Botanic Gardens, attended on the invitation of the Secretary of State, and Colonel Walker, Secretary of the Governors' Conference, functioned as organizing secretary. The Proceedings of the Conference have been published and distributed by the Governors' Conference Secretariat, Nairobi, in the series *Technical Conferences of the East African Dependencies*. The recommendations of the Conference have received the approval of the Secretary of State.

As a result of these deliberations there is now in existence a five-year programme for the work of the Station, which it is presumed will not be materially changed. To permit its inclusion in the present report, completion has been delayed until the intimation of the Secretary of State's approval was received. Since the Amani Conference Report is based on reference to the Report of the Committee of the Colonial Advisory Council the following version has been constructed from both documents.

Soil Investigations.

The following work to be undertaken :—

1. The collection of soil types and the compilation of a reference list of such types showing their characters and localities, with a view to the production of soil maps for East Africa.

2. Special studies of important soil groups, including the investigation of their fertility and their suitability and amelioration for crop production. In this connexion the following matters require attention :—

(*a*) The study of the physical and chemical properties of certain soils of East Africa known to be the subject of serious erosion.

(*b*) The study of the effect on the soil of the use of cover crops and green manure plants.

(*c*) The study of soil factors involved in the limitation of productivity of coffee, cloves, and tea in East Africa.

(*d*) The review of work being done generally in the tropics in connexion with " shifting " cultivation and the continued study of this subject in East Africa, with a view to Amani acting as a clearing house of information.

Crop Investigations.

In view of the importance to East Africa of the coffee and sisal industries, the research programme of the Amani Station should be largely directed towards work on behalf of those industries, and Amani should in fact become the main research station in the Empire for fundamental work on those crops.

Coffee.

1. Investigation of the possibilities of improvement by selection to be continued.

2. The genetics of coffee to be thoroughly investigated, not only in relation to yield and adaptation to local conditions but also with reference to pests and diseases.

3. The problem of the effect of shade on coffee to be recognized as a matter of the utmost importance, and the work already commenced to be continued and extended as far as possible.

4. The factors underlying the propagation of coffee by budding and grafting to be thoroughly studied, in order that assistance may be afforded to local Departments of Agriculture desirous of laying down seed gardens of selected material.

5. Investigation of the fundamental anatomy, physiology, and nutrition of the coffee plant, including studies of root systems and of the relation of reserves to productivity, with a view to securing an explanation of the tendency of coffee plants in parts of East Africa to exhaust themselves at an early stage by overbearing, and providing data of a fundamental character on which Departments of Agriculture can base their advice for the improvement of plantation practice in the matter of pruning, mulching, cultivation, weeding, and arrangement of shade.

Sisal.

In relation to the proposed establishment of one or more experiment stations for co-operative research into matters affecting the sisal industry, the Amani Station is to undertake the following sections of the programme :—

Genetics.—1. The raising of large numbers of seedlings to determine the range of variation available for selection.

2. Exploration of the possibilities of inducing seed production by (*a*) altitude, (*b*) mutilation.

3. The introduction, if they can be found, of new strains, and if success is attained under (2) their crossing to secure greater variation in the seedlings.

4. The production, if possible, of inter-specific hybrids.

5. Determination of the effects, if any, of vegetative selection as at present practised.

Physiology.—1. The study of the factors which influence poling.

2. Comparison of the number of leaves produced, and their rate of production, during the total life of the plant, under differing conditions of soil and climate.

3. Measurement of variation in the length of leaf, percentage of fibre, and total fibre under differing conditions ; also of the production of fibre in the plant and the amount of fibre and its quality at different stages of growth.

Tea.

Study of the suitability of different types for East African conditions.

Cinchona.

Pending further enquiries regarding quinine production, examination of the alkaloid content of the available species to continue to a limited extent with a view to the establishment of lines with high yields.

Pasture and Browse Plants.

Work on the botanical survey of pasture and browse plants to continue, Departments of Agriculture undertaking to supply to Amani seeds or stocks of indigenous plants of this nature.

Plant Pathology.

Research into the problems of virus diseases to be continued without interruption, especially on crops of importance in the East African Territories. (Virus diseases of maize, sugar-cane, groundnuts, tobacco, and cassava are already under investigation).

Entomology.

On the appointment of an entomologist, subjects for investigation to be selected by the Director of the Station, in consultation with

the Directors of Agriculture, from matters which fall under one or more of the following heads, preference being given to coffee and cotton, and to sisal when the occasion arises :—

1. Ecological aspects of entomological problems.
2. The resistance of plants to insect attack.
3. Insect nutrition.

Ornithology.

The value of the ornithological work undertaken by the present Secretary is recognized, and it is agreed that he should be available when required for consultation by, and visits to, the contributing territories.

Distribution of Plants and Seeds.

The collection of plants of possible economic value to be made as extensive as possible, the Departments of Agriculture undertaking to supply material of indigenous East African plants which may be of interest in this connexion.

Central Quarantine Station.

The establishment of a central quarantine station for plant introductions into the East African dependencies is recognized to be desirable, and Amani is regarded as the most suitable centre for this purpose.

Publications.

The policy is endorsed of allowing officers of the Station to publish their results in the appropriate scientific journals and of arranging for the issue of reprints of such papers under a distinctive cover.

Consultative Duties.

It is accepted that the Director and specialist members of the staff at Amani should be available for consultation by Departments of Agriculture in East Africa and that they should make periodic tours in the contributing territories, with the object of assisting the technical staffs of the Departments of Agriculture in regard to specific problems on which their advice is required. Specialist officers should also be prepared to assist in *ad hoc* investigations when departmental arrangements for them are found to be impracticable and when such investigations can be arranged for by the Director of Amani without interfering with the fundamental research work of the Station.

The special position of the Government of Zanzibar, which does not maintain a specialist staff in its Department of Agriculture, is recognized and it is agreed that the services of the Amani staff should be available when required, provided that interruption of work on the research programme is avoided.

CONFERENCES.

During the Director's leave in England he attended on behalf of the Station the following conferences :—

Imperial Entomological Conference, London,
Imperial Conference on Fruit Production, London,
Imperial Botanical Conference, London,
Imperial Soil Conference, Rothamsted,
International Horticultural Conference, London,
International Botanical Conference, Cambridge, and
Empire Cotton Conference, Didsbury.

AMANI PLANTATIONS.

Amani.

A minimum of attention was given to the Amani plantations during the year owing to the available labour being still largely occupied on constructional and maintenance work in connexion with roads, the distribution of electric current, the relaying of water mains, the rebuilding of native houses, and similar necessities. Arrangements have been made whereby during the ensuing year the plantation labour will be available for its proper purposes and maintenance work will be left in the hands of the Engineer. All the newly-introduced plants have received adequate care and the general nursery work has been maintained to a satisfactory standard. The requirements of the research officers, as regards the supply and care of plant material, have been fully met.

In view of the wide interest taken in the prospects of tung oil production a word should be added to the report given last year on the results so far achieved. These continue to be disappointing throughout the whole range of trials between sea level at Zanzibar and four to five thousand feet in the Moshi-Arusha area. At Amani only one or two of the plants put out have made any appreciable growth. On the other hand, plants of the same batch sent to Kenya are reported to be already flowering. It has been noted in the case of *Aleurites montana* that plants left in the original nursery bed have not shown the same tendency to arrested growth and two plants which have been isolated and left in position show quite satisfactory development. This has suggested experiments in planting at stake and these are now in progress.

The collection of plants for trial as temporary shade, cover crops, and green manures is increasing rapidly, especially in the number of leguminous plants indigenous to various parts of East Africa. The Station is much indebted to agricultural officers and others who have collected and supplied a considerable part of this material. The cultivation of plants with insecticidal properties is continuing and the appointment of an Entomologist will enable tests of their effectiveness to be undertaken.

Kwamkoro Estate.

The commercial coffee crop produced on this estate was again exceedingly disappointing. In consequence of this and of the fall in the prices obtainable, a policy of severe retrenchment was decided upon and submitted to the Amani Conference after its members had had an opportunity of inspecting the estate. The following decision was recorded.

> "We endorse the policy of the Director and consider—(*a*) that the retention of the Kwamkoro Estate is most desirable; (*b*) that during the next five years, active operations should be limited to the maintenance of approximately one hundred and fifty acres of coffee; (*c*) that expenditure on these one hundred and fifty acres should be limited to about £1,000 a year, and that any profits accruing should be set aside, firstly, to liquidate the amount owing by Kwamkoro to Amani, and, secondly, to be devoted to the further development of the estate, and to the planting of crops on which Amani research workers are engaged."

Certain parts of the estate are already in use for experimental purposes and the areas thus utilized will steadily increase.

Low-Level Station.

Apart from the carrying out of soil and plant surveys by the Soil Chemist and Botanist, respectively, work on the low-level station at Tengeni has remained in abeyance, owing to the uncertainty of the position with regard to the Sigi Railway which was expected to supply a means of access to it. Now that a decision to abandon the railway has been made and is likely to prove final, it is questionable whether Tengeni will afford the most suitable site. If the discussion which is now proceeding between the Sisal Growers' Association, the Department of Agriculture, and this Station results in the establishment of a special sisal experiment station, this will provide for the main purpose of a low-level station. The outcome of the negotiations must be awaited and meanwhile facilities for the planting out of sisal seedlings produced at Amani have been kindly provided by the Amboni Estates Limited and by Messrs. Bird and Co. A certain amount of general experimental work has also been carried out by officers of the Station on commercial sisal estates but the results, as is usual if not universal with this type of arrangement, have proved unsatisfactory and have demonstrated the necessity of an experiment station under direct control.

PUBLICATIONS.

From an institution mainly devoted to long-range research the publication of results in its early years must necessarily be small. During the year the results of many years of study of the problems of butterfly migration by Mr. C. B. Williams have been published

as a monograph. The considerable amount of evidence which relates to East Africa was collected by the author during his tenure of the post of Entomologist at Amani and, as elsewhere recorded, a grant was made from the Station towards the expenses of publication. The papers in the following list have been contributed by members of the staff to scientific journals :

1. Records of Butterfly Migration in East Africa. C. B. Williams, *Journ. East Afri. Ug. Nat. Hist. Soc.*, No. 35, 1929.
2. Collected Records Relating to Insect Migration : Second Series. C. B. Williams, *Transactions of the Entomological Society of London*, 78, Part I, 1930.
3. Locust Hoppers and Birds in East Africa. R. E. Moreau, *Bulletin of Entomological Research*, 21, Part II, 1930.
4. The Bird Population of a Settled Valley in the West Usambaras, Tanganyika Territory. R. E. and W. M. Moreau, *Journal of Ecology*, 19, No. 1, 1931.

The results of several investigations in the section of Plant Pathology are approaching completion and it is expected that by the time of the distribution of the next annual report a sufficient number of publications will have accumulated for an issue to be made to the departments and institutions which have entered into exchange relations with the Station.

LIBRARY.

Grateful acknowledgment must be made to the Carnegie Trustees for the grant of £2,000 which is being used to bring the Library up to date, especially as regards sets of scientific journals, and so to provide an East African reference library for workers in the agricultural and biological sciences. Thanks are due to institutions all over the world for their generous response to requests for back numbers of their publications.

PROGRESS REPORTS.

Outlines of the work undertaken during the year are given in the sectional reports over the signatures of the officers directly concerned. These reports are not intended as an exposition of the results obtained but as a record of the subjects actually under investigation and of the progress made. A satisfactory feature of the Amani Conference is that the Directors of Agriculture present fully endorsed the policy of concentrating the available resources of the Station on problems of long-range or fundamental research. Comparison of the work in progress with the programme approved by the Conference shows that no important readjustments are required to harmonize the two. From the points of view of the Research Station as instructed by the Secretary of State and of the

Departments of Agriculture representing the local Governments, the course of investigation is clear.

The agricultural industries with which the Station is specially concerned are coffee and sisal production. During the history of the coffee industry in East Africa comparatively little progress has been made in the adjustment of the coffee plant to the conditions, varying widely in soil, altitude, and climate, in which it is grown or attempted to be grown. The most general and serious expression of the lack of adjustment is the trouble commonly known as overbearing, which may be more exactly described as the inability of the plants either from the beginning or after a certain stage of development has been reached to carry a crop of satisfactory proportions without more or less serious injury expressed in the form of defoliation or dieback of the bearing branches. Particular forms of this general type of failure occur in widely different environmental conditions. The causes are not at all obvious and their discovery will probably require a patient disentanglement of the numerous factors affecting nutrition. With this in view the study of the carbohydrate-nitrogen ratios is being undertaken over a natural and artificial range of conditions while a beginning has been made in the investigation of possible soil deficiencies. By the methods of the plant breeder a more direct attack is being made on the problem through the endeavour to find varieties or strains so adjusted to local conditions that this form of trouble is not manifested. Another type of disability is being attempted to be met in the same way, namely, the reduced resistance to pests and diseases which clearly exists in relation to differences in the environment.

The ability of *robusta* coffee to flourish with a minimum of attention and produce regular crops in districts where *arabica* is difficult to grow has given rise in these areas to an inclination to change over to the first-mentioned species. Information specially collected by the Imperial Institute from a wide range of European marketing authorities definitely discourages the hope that even a carefully selected *robusta* produced on plantation lines would be successful in competition with the cheap coffees with which the market is already well supplied. Since, however, the production of *robusta* by natives, if not by Europeans, is likely to remain an important industry it is considered well worth while to proceed to take advantage of the obvious possibilities which exist of improving size, uniformity, and productiveness. For this purpose the existing plots at Amani afford material ready to hand and a number of new introductions have now reached the bearing stage.

With regard to sisal, the reports of the Plant Physiologist and the Geneticist show the nature of the investigations which it has been found possible to initiate pending the provision of an adequate area for plot experiments. Subsequent to the demonstration of the possibility of growing sisal from seed, with the prospect of selection

which this affords, it appears that a successful beginning has been made in the production of hybrids which should still further widen the range. Methods have been devised which it is hoped will enable the comparative estimation of fibre content to be readily made in the laboratory.

In the section of Plant Pathology the discovery, in the insect vector of streak disease of maize, of sex-linked inheritance of the ability to transmit the disease will be noted by all investigators of this difficult group of affections as a definite contribution to knowledge, opening up interesting avenues to further exploration. The co-operative investigation with the Nyasaland Department of Agriculture initiated by Dr. Storey during his visit in 1929 would appear, subject to confirmation of the results already obtained, to have provided a simple and unique remedy for the serious tea disease known as "yellows." The bark disease of young coffee shoots investigated in the Usambara district, an account of which has been prepared for publication, has been found to have a wider distribution than was at first apparent, and this may be expected to be still further extended when the definite description is available.

VISITORS.

In addition to the delegates to the Amani Conference mentioned above, the Station has been visited during the year by Professor Macmillan of the Witwatersrand University, Johannesburg, Mr. A. Wigglesworth, Mr. R. Buxton, and Colonel Julyan, Warden of the Lord Wandsworth College. Official visitors from the East African Dependencies include Mr. R. W. Taylor, C.B.E., Treasurer, Tanganyika Territory; Colonel G. A. P. Maxwell, D.S.O., M.V.O., M.C., General Manager of Railways, Tanganyika Territory; Mr. A. J. Wakefield, Senior Agricultural Officer, Moshi; Mr. H. D. Aplin, C.M.G., Secretary for Native Affairs, Nyasaland; Mr. J. C. Abraham, M.B.E., District Officer, Nyasaland; Major W. C. Lead, M.C., M.L.C., Major von Brandis and Mr. A. Leigh (Secretary) representing the Tanganyika Sisal Growers' Association, and Mr. W. C. Hunter, Secretary of the Kenya Sisal Growers' Association.

W. NOWELL.

Director.

REPORT OF THE PLANT PATHOLOGIST.

The aims of the plant pathological investigations at the Station and the proposed lines of approach were stated in my second annual report; no important alteration in this programme was found to be necessary during the ensuing year. I was absent on leave for half the year; nevertheless certain advances can be

recorded. At the time when this report is being written several of the investigations which have been in progress since the re-opening of the Station are nearing that measure of finality which justifies publication of results.

The chief item in my programme of work is the study of plant virus diseases. In particular I have concentrated upon the continuation of the studies of streak disease of maize which I began in 1922. This disease has proved a particularly favourable one for detailed investigation of the processes of insect transmission of a virus. The technique which has been worked out allows of a study of the behaviour of *individual* insects, in a manner which has hardly been attempted by most workers with virus diseases. One outcome of this intensive work was the demonstration that certain leafhoppers of the species, *Cicadulina mbila* Naude, unlike the bulk of their fellows, were unable to transmit the virus of streak. During the present year I have been able to show that the power of transmitting the virus is an hereditary character and to elucidate its manner of inheritance. In some respects this discovery throws new light upon the relation between a virus and its insect vector. An important outcome, from the point of view of further research, is that I am now able to breed races of hoppers, every individual of which is a potential transmitter of the virus. Furthermore, the races which are unable to transmit the virus provide fruitful material for the study of the basis of this inability. An account of this work will soon be prepared for publication.

Progress has been made along certain of the other lines of investigations of virus diseases. In particular the technique of feeding leafhoppers through membranes has been developed to the stage where it can be used as a daily working-tool. This development opens the way to a study of the streak virus *in vitro*, a field which has been closed hitherto owing to the impossibility of ascertaining the presence or absence of this virus in a solution by direct inoculation into plants. The technique has been applied to studies of the filterability of the streak virus. A description of this work is being prepared for publication.

An investigation which has occupied a large part of my time is the attempt to solve the problem of the "yellows" disease of tea in Nyasaland. Collaboration with Mr. R. Leach, the Mycologist to the Department of Agriculture in that territory, has continued. The problem has proved to be an elusive one and, even now, although preliminary results give promise that a practical remedy will be found, it is uncertain whether the disease is to be attributed to a virus, fungal parasite, or nutritional deficiency. The investigation is one which must necessarily be done mainly in Nyasaland, but the equipment at Amani makes it convenient to carry out here certain experiments in the testing out of hypotheses advanced to explain the disease.

During the past year the investigation of the bark disease of coffee in the Usambara district has been brought almost to a conclusion. A report on this work will be published in the course of the next year. The physiological studies of the leaf-curling disease of tobacco, to which reference has been made in previous reports, led to no conclusive result. A new line of attack is now being followed, and early results give support to the expectation that it will lead to a solution of the problem.

H. H. Storey,
Plant Pathologist.

REPORT OF THE SOIL CHEMIST.

The period of six months from 1st April to 2nd October was spent in acting charge of the Station in the absence on leave of the Director and the next senior officer. During the same period the office staff was reduced by the absence of the Secretary and the Stenographer. The time available for personal work on soils was therefore very little during these months, and rarely amounted to more than one or two full days per week. This report, also, is being written in early February before I myself proceed on leave, so that the effective period under review is considerably less than a full year.

In the report for 1929–30 the programme of work selected for immediate attention was outlined. Progress during the year is reported below under the same heads.

1. *General Survey and Classification.*

Steps have been taken towards defining the share which should fall to Amani in the work of soil survey in East Africa, in collaboration with the several territorial Departments of Agriculture. As a result of correspondence initiated from Amani in April the following general lines of work have been agreed upon, to be arranged for more particularly when the soil chemists can meet (it is hoped in 1932) in conference.

Certain stages of the work are to be decentralized as far as possible, viz. :—

(*a*) The assembly of existing soil records for each territory.

(*b*) The collection of new data in the field.

(*c*) The examination and grouping of the data for each territory so as to bring together its important soils and shew their distribution ; the formulation of generalized descriptions of the soils so recognized, so far as the laboratory work possible at the territorial centre allows ; and the selection of samples to be forwarded to Amani, to represent the soils and their ranges of variation.

Further stages are to be centralized at Amani, viz. :—

(*d*) The chemical work, beyond that found possible at the territorial centres, necessary for fully characterizing the contributed type-samples and settling their places in an agreed classification.

(*e*) The preparation of a soil map (or atlas of maps) on a scale suited to the detail available for each section of it. The first state of this map will be a mere diagramatic index, on which, without attempting to distinguish soil types or join up boundaries, the localities for which exact soil information exists will be posted as information becomes available.

(*f*) As data accumulate, the drafting of a scheme of classification and nomenclature, to conform so far as may be with modern practice elsewhere, having regard to the requirements of the data themselves. Full consultation with the territorial specialist officers, and with the Imperial Bureau of Soil Science, is intended at this stage.

(*g*) The comparison of soil types proposed from different territories with a view to recognizing kinships and differences, and the gradual conversion of the "index map" to a soil map proper, with consistent naming of like soils throughout.

(*h*) The establishment at Amani of a permanent reference-collection of East African soils—the material to consist of the type samples contributed from the territories, displayed as far as possible for convenient examination by visiting officers.

The application of these general principles will not be quite alike for all the six territories. Since Amani is in Tanganyika, the soil chemist here will inevitably become more personally familiar with Tanganyika soils than with others, and decentralization of the earlier stages of survey will be less rigorous. Until the appointment of a soil officer for this territory, indeed, *all* stages will fall to Amani to conduct, but this position will, it is hoped, be remedied within the coming year. For Zanzibar, also, Amani will continue to be the centre for handling soil material, as the resources of this Protectorate do not permit of the employment of a soil specialist.

The transmission of type-material to Amani from the other territories in the sense of the above proposals has not yet had time to begin, but a number of Agricultural Officers in Tanganyika (viz., those in Dar es Salaam, Rufiji, Kasulu, Sumbawanga, Biharamulo, Moshi, Arusha, and Lushoto) have submitted valuable notes and profile-samples relating to representative soils in their areas. Grateful acknowledgment is made of these important contributions of data, both to the officers themselves and to the Department of Agriculture, Morogoro—the support of whose late Acting Director (Mr. Wolfe) and present Director (Mr. Harrison) in this work is greatly appreciated. The submission of an interesting series representing soils in the Mbulu area (south-west of Arusha, Tanganyika)

by the Senior Veterinary Officer there, and the making available in manuscript form of detailed soil notes relating to the Uluguru Mountains and localities in the Iringa Province by the Land Development Survey Commissioner, Tanganyika, are similarly acknowledged.

In the same sense, acknowledgement is made to the Botanist and to the Physiologist of this Station for data and samples from Zanzibar and Pemba, and from coastal areas under sisal cultivation, respectively.

The total number of samples now available for study at Amani—the great majority of them collected or contributed with the purposes of this (Survey) section of the work in view—is now about 800, representing 167 soils.

As regards progress in the working-up of the information and material that has been accumulated, it is considered too early to report at this stage upon conclusions from laboratory work, or upon the characterization of soil groups. The subjects of classification and nomenclature and of suitability of analytical methods are to be considered at a proposed meeting of the soil chemists of the six territories in 1932. The "index map," on the scale of 1 in 2,000,000, has been brought to its first state so far as the first-hand data gathered from or contributed to Amani are concerned, but much information available from elsewhere remains to be entered upon it before it exhibits the true extent of soil knowledge for the territories to date.

2. *Special Studies of the Soil Groups.*
6. *Erosion.*
8. *Manganiferous Soils.*

Reports on progress under these heads would necessarily be technical and, as no part of the work is complete enough for publication, an account of them is deferred for a subsequent annual report.

Attention has been mainly devoted to the series of soils encountered in the survey of the Tengeni estate, referred to in last year's report. Some additional examples of erodible soils were examined in the field during a short journey in the Malindi-Mlalo area, West Usambara, in November, 1930, and material brought in. The amount of such material or of experience of such soils in the field is, however, too small for the beginning of serious work on the subject of the chemical and physical properties of soils liable to erosion.

Further analytical methods (determination of organic carbon, of phosphorus by colorimetric methods, of pH value, of exchangeable bases, of "sticky-point") have been tried out on a wide range of East African soils. Thirty representative soils were sent to England for the purposes of Professor G. W. Robinson's researches on mechanical analysis under the auspices of the Imperial Bureau

of Soil Science, and results from this laboratory have been submitted for these soils for comparison with Professor Robinson's results. Reports of the work under these heads are also reserved for later publication.

At the request of the Department of Agriculture, a scheme for manurial experiments on tobacco in the South Tanganyika highlands was drawn up and submitted in October, 1930.

Chemical work on soils and plant-material, in collaboration with the Pathologist's study of the so-called " yellows " disease of tea, is being undertaken and will be reported on at a later date.

As stated in the last annual report, Mr. W. E. Calton took up the duties of laboratory assistant in March, 1930. A considerable part of the analytical work of the year has been in his hands, and he will continue with this along lines laid down, during the Soil Chemist's absence on leave from February to October, 1931.

Travelling.—The only journey of note that could be undertaken during the year was a tour of West Usambara coffee estates, in November, 1930, which has been reported upon separately to the Director.

G. Milne,
Soil Chemist.

REPORT OF THE BIOCHEMIST.

From 6th May to 26th November the Biochemist was on leave. Of the time spent in Amani nearly all has been devoted to the testing of, and preliminary work on, the new apparatus designed in conjunction with the Plant Physiologist for the determination of total carbon in plant tissues, and also to perfecting a rapid method for the determination of sugars, i.e., carbohydrate carbon in the same materials. Both these determinations, which are required in the proposed work on the C/N ratio of the coffee plant, have proved satisfactory and a description will shortly be published in one of the scientific journals.

The method for estimating nitrogen in plant tissues, which is to be employed here, being a standard one, the main work on the C/N ratio can now be commenced.

Preliminary trials with extracts of certain plants, used locally as fish poisons, to replace the more poisonous insecticides such as nicotine, have been made and promising results obtained, but the detailed testing of these will be made in conjunction with the new Entomologist on his arrival at Amani.

In accordance with the programme of work approved for this station, chemical work on the cinchona alkaloids has, at any rate for the time being, been suspended.

R. R. Worsley,
Biochemist.

REPORT OF THE PLANT PHYSIOLOGIST.

The attention of this section has been confined, as previously, to work on sisal and coffee. Any physiological problems which appear of interest are receiving attention in the case of sisal, while in coffee attention is more or less restricted to the effects of shade on the plant.

During the past year, improved laboratory facilities in the shape of gas and electricity have been available. This has enabled more laboratory work to be undertaken, notably in connexion with the carbohydrate-nitrogen ratios of coffee.

A considerable amount of time has been devoted to an attempt to train selected African observers to make routine measurements of plants in the field. Little success has been obtained, natives being always very slow and, in addition, unreliable. They are able to carry out measurements with accuracy for a short time only, then, for no apparent reason, a period of great inaccuracy supervenes. A crying need exists for observers capable of carrying out simple measurements with speed and accuracy.

An exhibit illustrative of the work of the section was prepared for the Nairobi Agricultural Show and was demonstrated there.

COFFEE INVESTIGATIONS.

Shade Experiment.

The collection of data from these trees has continued uninterruptedly throughout the year. Trouble has been experienced from the repeated theft of the fabric used for shade, leading to a considerable waste of time and money in renewing the material. To the data already recorded are now added flowering and fruiting records, one series now flowering for the second time at an age of seventeen months from seed.

Little trouble from disease was experienced until January, 1931, when a very heavy attack by *Hemileia* took place. As the distribution of the infection as well as its severity is affected by shade, records of the attack have been made. The effect of such a differential infestation on the ultimate results of the experiments cannot yet be estimated. It is noteworthy that under certain conditions *Hemileia* can be a much more serious disease of coffee than is generally recognized in East Africa.

In addition to its original purpose, this experiment is furnishing material for the study of the C/N ratios of the plant, and other laboratory investigation.

Field.

Records are being taken of growth of coffee in the field on an estate about fifteen miles from Amani in shaded and unshaded situations. It is hoped to set out a similar experiment at Kwamkoro, saving an appreciable amount of time in travelling. Visits have also been made to estates in Kenya, where problems were seen in the field.

Laboratory.

In collaboration with the Biochemist, suitable technique for the chemical estimations involved in this work has been developed and suitable apparatus devised which will be described in due course. On my return from leave the main work on this problem will be started. Almost all the time available for laboratory work has been taken up by this, and consequently but little other laboratory work has been done. However, stomatal records of the coffee plant, both in the field and in the laboratory, have been made and are being continued as time permits.

SISAL INVESTIGATIONS.

Visits have been made to representative sisal estates in Tanganyika and Kenya, and field data collected. A summary of the type of data obtained is given under " Travelling."

A visit to Naivasha in Kenya enabled the effect of conditions of drought on sisal to be seen. The peculiar climatic conditions there prevailing accentuate a number of problems to which it is hoped to give attention in due course. Amongst these are :—

(*a*) The nature of the transmission of stimuli between a plant and its attached suckers. Numerous field observations have established the existence of such transmission.

(*b*) The factors influencing the formation of well-developed capsules with viable seed which is a characteristic feature of this area.

(*c*) The physiological basis of the varietal drought resistance which observation has shewn to exist. As much sisal is grown in areas of low rainfall, this appears to be of some importance.

During the course of field work, it became obvious that definite conclusions cannot be expected from such work, which more properly leads to an outlining of subjects for research and to a clarification of ideas. It is now felt that the future of research on sisal depends on the provision of facilities for experimental work in the sisal belt. My personal opinion is that co-operative work on plantations, by which is meant the laying out of experiments on commercial estates, will be of very limited use.

Nothing less than the provision of a suitable area for sisal growing under the personal supervision of a scientific officer, with some laboratory facilities on the spot, will serve to furnish the sisal industry with the fundamental data which it so sadly needs.

TRAVELLING.

The following places have been visited in connexion with sisal and coffee investigations. A summary of the type of data collected is given under each estate :—

Estate.	*Area.*	*Crop.*	*Data.*
Amboni	Tanga	Sisal	Calcium manuring. Fibre variation. Growth rates of suckers and bulbils. Leaf counts. Root systems. Soil samples for eventual correlation with plant growth.
Kigombe	Tanga	Sisal	Influence of cutting on initiation of poling. Leaf counts. Root systems. Soil samples.
Mwera	Pangani	Sisal	No data.
Mjesani Lanconi	Tanga	Sisal	Influence of cutting. Bud mutations.
Longonot	Naivasha	Sisal	Bud mutations. Fruiting relations. Varietal drought resistance. Transmission of stimuli. Influence of cutting.
	Ruiru	Sisal	Varietal drought resistance. Fruiting relations.
Mavumi	Amani	Coffee	Growth rates.
	Limuru Kiambu Ngong Ruiru	Coffee	Influence of shade, altitude, etc.

F. J. Nutman,
Plant Physiologist.

REPORT OF THE PLANT GENETICIST.

During the year, work in the section of plant breeding has followed the lines indicated in the last annual report with a few alterations and additions suggested in the course of the work.

Five weeks were spent on safari, mainly in the coffee growing areas of Kilimanjaro and Meru, but several sisal estates in the Usambara and Pare areas were also visited.

Contact with the Imperial Bureau of Plant Genetics, Cambridge, has been established and maintained. The Bureau has proved

very helpful in supplying references to and abstracts of recent work on the crops under investigation which normally would not have become known for some time. Much other help has also been given.

In order to keep in touch and where necessary assist with work on crop improvement by selection or breeding which is being carried out by the Department of Agriculture in Tanganyika, direct communication with the officers concerned has been established.

Progress of work during the period will be considered under the headings of the particular crops.

COFFEE.

Coffee plants in the field have made satisfactory progress during the year. Plots of selected strains which suffered during the locust invasion of 1929 have had to be dealt with very drastically; the majority are making a fair recovery. Those planted during 1930 suffered owing to the intermittent very light rains after planting but have since, in the majority of cases, made satisfactory growth.

Plots of *robusta* coffees have flowered at the age of two and a half years from seed and some trees of *arabica* selections have borne a first crop at three and a half years from seed. The few plants grown from self-fertilized seed of selected *robusta* parents were planted out when sixteen months old and are growing well.

The incidence of various diseases and pests has been noted on coffee during the year; *Hemileia* in particular has caused considerable defoliation.

Work on selection of seed from trees showing valuable characteristics has been carried on. A survey of *robusta* plantations in Amani has led to the selection of several strong, healthy, high-yielding trees. These trees produce a large bold bean, even in size. The remainder of the trees in the plantations have been stumped to permit the collection of seed of the desired types, ruling out crossing with poorer types.

While on safari one or two estates were visited which had suffered to a very considerable extent from disease—leaf diseases, overbearing, and dieback. In some cases the majority of the trees in certain areas were, to all appearances, dead. In these areas there were surviving trees, bearing heavily, in full leaf and good health. When visited twelve months previously these same areas were uniformly good. The survivors did not appear to have any advantage, regarding their immediate environment, over their neighbours. From these trees seed was taken for propagation. Some selections were made from trees showing marked differences from the general type and others from vigorous specimens from among apparently pure stands of one type.

Breeding work on coffee has been a continuation of investigations into reproductive and vegetative characteristics of typical plants. Attempts have been made to secure self-pollination in various

species. Branches have been isolated in cages covered with different materials. Very little difference has been observed in comparative behaviour under these materials, but as open a texture as possible, so long as it is capable of excluding insects, seems to be most suitable. Emasculated flowers caged with mosquito netting have failed to set seed when the surrounding bushes have been in full bloom.

Hybrid cherries have been obtained in a cross between a variety of *C. arabica* and a selected *robusta* plant. Knowledge of the behaviour of selected strains is still incomplete and until the mature plants have been studied closely over a longer period attempts at improvement by hybridization will only be of a tentative nature.

The need for rapid propagation of valuable types of plants has led to a series of investigations of vegetative reproduction in coffee. Cuttings at various stages in development of the parent plant have been made and these have developed with varying success.

The first series of experiments has been concluded and a further series commenced. Various methods have been tried to reproduce vegetatively by grafting and budding, and these experiments are still being continued.

Other experimental work includes an investigation into periodicity in flowering and bearing and, at the same time, an endeavour to correlate yielding capacity with vegetative characters of a plant.

Quality of produce is another line which is being investigated. A study of parchment samples from various localities has been made without obtaining much evidence of any variability in quality from different districts. It has been stated that quality varies with density of bean. There does not seem to be any correlation between quality, judged on price, and density. It appears that quality can vary considerably through differences in the preparation.

The use of cover crops and green manures in coffee and the growing of plants for temporary shade during trying periods in the life of plants are also being investigated. Progress in this line of investigation is slow owing to the variation of requirements according to situation and climatic conditions. Further notes on this work will be found under the heading " Cover Crops."

SISAL.

Field investigations have included an inquiry into the relationship existing between the parent plants and suckers and also the relation between parent and bulbil offspring. In some cases it has been observed that poling parent plants are accompanied by poling suckers, the sucker plants still being in an immature form. In the majority of cases however the suckers seem to develop normally while still attached to the parent plant. The difference found in the behaviour of suckers cannot be accounted for on a climatic basis, and variation in behaviour induced by soil variations has not yet been investigated.

In one particular case poling suckers with well-developed and rudimentary poles respectively were detached from the parent and replanted. Those bearing well-developed poles flowered and produced bulbils. Those showing rudimentary poles began to develop leaves again at the apex of the incipient pole; in one case a new series of roots was formed from the base of the re-developing portion, apparently originating from the axils of the scale-like leaves of the rudimentary pole ; in the other case vegetative development was resumed at the apex of the pole, thus forming a continuation of the original plant with a few inches of pole in between the base and the new head.

Bulbils arise as vegetative buds in the axils of the bracteoles on the pedicel of the flower. In the normal course of events they appear after the flower has fallen.

Seed pods were not observed on any of the estates visited ; mutilated poles showed the normal sequence of flowers and bulbils.

An unidentified agave in the Amani collection flowers and produces seed readily. This plant is a species bearing many short leaves carrying marked up-curved, red, lateral spines. Pods have been obtained on one plant by emasculating the flowers and pollinating with pollen from *Agave sisalana*, the ordinary cultivated sisal. The pods are not yet ripe and it is not known whether viable seed will be obtained.

The seedling material obtained from the Kenya Sisal Growers' Association has been closely studied. A very varied form of leaf is shown and quite a marked variation in the number, shape, and size of the lateral and terminal spines. No forms can be said to be spineless at this stage although there are signs that some forms will lose their spines as the plants grow older. The parent material from which the seed was obtained shows only a moderate proportion of spiny plants. With the assistance of the Tanganyika Sisal Growers' Association this material has now been planted out on areas of land set aside for this purpose by two sisal estates. One estate is in the coastal area and the other inland, both within easy reach of Amani.

Other investigations on sisal have included tests on samples of leaves from single plants and an endeavour to correlate fibre content with external leaf characters. Differences have been found in fibre content of leaves from different individuals but until further investigations have been made on larger numbers of plants the validity of the results obtained is difficult to determine.

COVER CROPS.

During the period October, 1928, to March, 1931, some one hundred and eighty-five species or varieties of thirty genera, mainly *Leguminosae*, have received trials in small plots. The most promising have been propagated for field trial and a few have received a first trial on a small scale in the field.

The plants have been studied from the point of view of their utility in increasing fertility, soil protection and wash prevention,

combating weeds, and as temporary shade and protection for other crop plants, such as tea and coffee, at certain periods of the year.

Seed of forty-three species and varieties of plants indigenous to Tanganyika Territory, Zanzibar, and Uganda has been collected and seed of other species has been introduced from other countries. A small collection is being maintained, as far as possible, of all plants for eventual trial under other conditions where they may prove useful.

In several cases seed of promising material has been sent to planters for trial.

TEA.

Little progress has been made with this crop during the year. A study of available varieties has revealed the presence of the same types in practically all the so-called varieties which have been imported. Plants of each type are being propagated from seed. Through the agency of the Indian Tea Association seed of the typical Assam teas is being obtained.

The bushes in the field have made satisfactory growth during the year.

L. R. Doughty,
Plant Geneticist.

REPORT OF THE SYSTEMATIC BOTANIST.

During the year the following investigations and work were carried out in the Systematic Botany section :—

THE HERBARIUM.

Contributions.

Fifty-one contributions representing a total of two thousand eight hundred and twenty-nine specimens were received from the following :—

Agricultural Department, T. T. (officers of)	451	specimens.
Veterinary Department, T. T. (officers of)	190	,,
Land Development Survey, T. T. (Agricultural member)	132	,,
Zanzibar Museum and Agricultural Department	96	,,
Royal Botanic Gardens, Kew... ...	880	,,
Messrs. Wigglesworth and Co., Ltd. ...	23	fibre specimens.
Amani staff (including unnamed German collections)	1,049	specimens.
Miscellaneous contributors	8	,,
Total	2,829	

Determinations.

A total of one thousand seven hundred and sixty-one specimens were determined for :—

Agricultural Department, T.T., in connexion with botanical surveys and economic plants.

Veterinary Department, T.T., in connexion with indigenous browse and fodder plant investigations and plants suspected of being harmful to stock.

Land Development Survey, T.T., in connexion with land land development in Iringa Province and the Ulugurus.

Zanzibar Museum, Zanzibar, in connexion with the botanical survey of Zanzibar and Pemba.

Department of Agriculture, Zanzibar, in connexion with economic plants.

Amani :—

Pathologist in connexion with plant disease investigations.

Geneticist in connexion with green manure and cover crop investigations, etc.

Soil Chemist in connexion with soil surveys.

Secretary in connexion with ornithological investigations.

Superintendents in connexion with economic plants.

Loan of specimens.

Specimens and types were loaned to :—

British Museum ...	91 sheets	*Combretum* spp.
Royal Botanic Gardens, Kew	4 sheets	Giant Senecios.
Imperial Bureau of Mycology	1 sheet (returned)	type of *Napicladium Calotropidis* Morstatt, per Mr. R. M. Nattrass.

Exchanges of Botanical material.

Specimens were exchanged and distributed as follows :—

From Royal Botanic Gardens, Kew, 880 sheets named East African specimens received.

To Royal Botanic Gardens, Kew	1,563	sheets.
Botanical Section, Division of Plant Industry, Pretoria	171	,,
Imperial Forestry Institute, Oxford ...	154	,,
British Museum, London	129	,,
Department of Agriculture, T.T.	108	,,
Veterinary Department, T.T.	107	,,
Bureau of Plant Industry, Washington, U.S.A.	25	,,
Total Distribution	2,257	

Named specimens in the Herbarium.

A census of all the named specimens in the herbarium was made and on deducting the figures of those filed away since May, 1928, the German collection numbered ten thousand and seventy-nine sheets. During 1928 and 1929, one thousand eight hundred and two named specimens were mounted and filed in the herbarium. This year, three thousand one hundred and sixty named specimens were mounted and incorporated, making a grand total of fifteen thousand and forty-one specimens available for study in the herbarium.

Types.

While determining specimens for various departments thirty-three type specimens were found and recorded making a total of forty-seven types in the herbarium.

Unnamed German Collections.

A start was made during unofficial hours on the unnamed German collections in the herbarium. The families *Leguminosae* and *Rubiaceae* and about fifty smaller families in the Dicotyledons were determined as far as possible from the literature and from named specimens in the herbarium.

The duplicates were sent to Kew for verification and the *Leguminosae* and *Rubiaceae* have been verified by that institution. There is still a great quantity of this unnamed German material to be identified and distributed.

Information.

Notes on various economic plants were supplied from time to time to correspondents, and full particulars on herbarium management and equipment were supplied to the Research Station, Mazabuka, Northern Rhodesia. Information on botanical survey work was supplied to various members of the Agricultural Department, Tanganyika Territory, the Department of Agriculture, Nyasaland, and the Veterinary Department, Tanganyika Territory. Information was also supplied to the Imperial Bureau of Plant Genetics : Herbage Plants.

FIELD WORK.

Botanical Surveys.

Work on the botanical survey of the economic plants established in the Amani plantations was continued and the collecting of specimens and data in the plantations is almost completed.

In August and September, a few weeks were spent at Mpwapwa and Morogoro. At Mpwapwa, the headquarters of the Veterinary Department, Tanganyika Territory, browse and fodder investigations were discussed with the Deputy Director, Mr. H. Hornby.

O.B.E. A botanical survey of the area was made and specimens collected of which duplicates have been sent to the Department. A report of this survey was submitted to the Director together with a list of the flora that had been recorded from Mpwapwa during the past three years.

When returning, a visit was paid to the Department of Agriculture, Tanganyika Territory, at Morogoro and a trip collecting botanical specimens was made down the Morogoro-Kisaki Road as far as the Ruvu River.

Verifications of nearly all the specimens collected on these trips, excluding the grasses, have been received from Kew and it appears that a number are new to science.

During the latter part of November and December advantage was taken of a local leave period to re-visit Zanzibar and Pemba to continue the botanical survey of the Protectorate, initiated in January–February, 1929, on behalf of the Zanzibar Museum. Transport facilities were provided by the Museum which enabled me to cover much ground in the two Islands and I was able to photograph the different types of vegetation, collect over two hundred botanical specimens in triplicate and twenty soil samples for the Soil Chemist.

The botanical specimens have been provisionally determined and a set has been sent to Kew for verification. On receipt of the verifications from Kew a set will be forwarded to the Zanzibar Museum for their herbarium ; the other set will be filed in the Amani herbarium for future reference.

Economic Plant Introduction.

Thirty-five packets of seeds and plants for trial as cover crops, green manures, coffee and fibre plants were collected and handed to the Geneticist and Plantation Superintendent.

P. J. Greenway.
Systematic Botanist.

ORNITHOLOGICAL WORK.

While on leave in the United Kingdom, close relations were established with the British Museum authorities. Tanganyika Territory as a whole is poorly represented in the National Collection and the peculiar Usambara district practically not at all. It was arranged therefore that a small grant should be made from the Godman-Salvin Fund to enable a native collector to be employed for a few months, the pick of the results to go to London. This arrangement has been mutually advantageous as it has been the means of supplying much new data on bird-ecology.

Observations on the various aspects of bird-biology referred to in last year's report are being continued. Attention is being concentrated upon :—

(*a*) A detailed local survey directed to ascertaining the distribution of all species represented with reference to elevation, climate, and botanical environment, and to their recorded distribution elsewhere in Africa. This involves work on the micro-climate of the forest. The results will contribute towards a perception of the general principles governing the distribution of birds in Tropical Africa.

(*b*) A critical study of the local breeding seasons, to be related so far as possible to those of other localities, as a contribution to the problem of what determines the breeding season of birds not subjected to annual length-of-daylight fluctuations of appreciable extent.

R. E. Moreau.

REPORT OF THE SUPERINTENDENT OF PLANTATIONS.

The Assistant Superintendent of Plantations returned from leave on 12th May, 1930, and the Superintendent went on leave on 30th January, 1931.

GENERAL.

The supervision of construction and maintenance of buildings, roads, etc., continued to occupy almost the entire duties of this office, and the works to absorb the greater part of the Station labour.

Towards the end of 1930 the call on labour for construction work lessened, and it was then possible to apply the released labour and attention to the Plantations and Nursery. Before this time little was done in the Plantations beyond keeping clean the young and more recent plantings. When more labour became available several older plantings were cleaned. Stands of *Juniperus procera* and species of *Cedrela* (planted just after the war on forestry lines) were thinned for the first time.

Much work was done for the Geneticist, including stumping coffee, planting cover crops, and experiments in rooting coffee cuttings. A considerable amount of other nursery work was done for the Pathologist and Physiologist.

SPECIAL CROPS.

The progress of the plants in the trial plots of *Aleurites Fordii* is not encouraging but investigations into the cultural requirements of this species and *A. montana* are being continued.

A planting of seventy-six trees of a very large podded variety of *Ceiba pentandra* (kapok) was made early in the year. The young trees have made rapid growth.

Trees of *Hydnocarpus wightiana* (Chaulmoogra Oil) set fruit for the first time. The whole plantation continues healthy and vigorous.

SEED AND PLANT DISTRIBUTION.

A further ten pounds of seed of *Aleurites montana* was received from Kew; seventy-one packets and twenty-four plants were received from other sources. Seed obtained from other countries often fails to germinate, and the number of species introduced cannot be taken as actual additions to the Amani collections.

The following list shows the distribution :—

Coffee seed	478 lb.
Cover crops and other small seeds	27 lb.
China grass rhizomes	24 lb.
Ginger rhizomes	5 lb.
Cuttings, mixed species	635
Packets of seeds	397
Plants	245

Three thousand seedling sisal plants were despatched to nearby sisal estates for experimental work in conjunction with Amani.

PROGRAMME OF WORK FOR 1931–32.

Plantation and Nursery labour being now available for its proper work, the ideal programme for the Plantations and Nursery becomes more possible of attainment. In addition to the maintenance of the existing collections the chief lines of work projected are as follows :—

1. The supply and care of plants for the investigational work of the scientific staff. This is inevitably a somewhat unknown quantity and continued preparedness for immediate activity is essential.
2. Increase of the collection of economic plants of the Station by seed and plant introduction.
3. Experiments in the propagation and cultivation of economic plants.

CONSTRUCTION AND MAINTENANCE.

The following works have been carried out under the immediate supervision of the Engineer, Mr. T. V. Greenwood :—

Electricity Supply.

The installation of the hydro-electric plant has been completed; all the laboratories, offices, and European staff quarters have been fitted up with electricity for power and light—this has necessitated approximately three miles of overhead distributing wires and the internal fitting and wiring of twenty-two buildings. Since its inception the electricity supply has been ample and satisfactory.

Laboratories.

Additional benches, tables, cupboards, and bookcases were made as required, and the necessary extensions made of the supplies of gas, water, and electricity.

The nursery greenhouse was reconditioned and heating apparatus refitted to the propagating frame.

Staff Quarters.

A new four-roomed house has been completed in readiness for the Entomologist's arrival. The old German House 8 has been enlarged and partly rebuilt to serve as married quarters for the Geneticist. The building originally used as a dispensary has been completely renovated and altered so as to be suitable as quarters for the Indian Fitter. Minor alterations and repairs have been made to several other houses, and motor-car sheds have been provided where required.

Roads.

The main road to Muhesa has been kept in a fair state of repair with funds provided by the Public Works Department. The bridge at mile 1 has been completely rebuilt and four small bridges reconditioned. Repairs have been carried out to the abutments of Longusa bridge which has been partly redecked. Sigi Bridge has had new girders and new decking.

Transport.

Owing to the continued inactivity of the Sigi-Tengeni Railway, transport of all stores and materials, etc., has been carried on by road from Muhesa. The three old lorries which had become uneconomical and unreliable were sold and a new Chevrolet lorry purchased. The Thornycroft six-wheel lorry has been used for heavy transport and also for the transport of logs to the saw-mill at Kwamkoro.

Timber.

All timber used for buildings, equipment, and bridges was felled and sawn by the Station. Mvule (*Chlorophoa excelsa*) has been found to be the most generally satisfactory and is used almost exclusively.

Gas Plant.

The Mansfield gas plant has maintained a continuous supply of gas throughout the year.

K. E. Toms,

For Superintendent of Plantations.

REPORT OF THE SECRETARY AND LIBRARIAN.

The Secretary was on leave during the first half of the financial year and as the Stenographer was absent from the Station for part of the same period it was found necessary for the Assistant Secretary and Librarian to devote himself entirely to the office. The essential work of the Library was accordingly carried on by Mr. R. F. W. Nichols in such time as he could spare from the Pathological Laboratory. The volume of office work has remained unexpectedly heavy owing to accounting requirements.

The event of the year with regard to the Library has been the receipt of a grant of £2,000 from the Carnegie Trustees towards the expenses of making good the neglect of war and post-war years. As indicated in last year's report, the gravest need of the Library has been to supply the series of periodicals missing between 1914 and 1928. Such sets are expensive and, having regard to the concurrent need for long series of various publications in the English language that under the German regime were not represented at all, it would have been easy to spend more than the whole of the grant on back numbers of necessary periodicals at once. A proportion of the grant has, however, been earmarked for the purchase of books and every effort is being made to buy the periodical series we need second-hand and at favourable opportunities.

Meanwhile, correspondents all over the world have responded with the utmost generosity to appeals for their publications. Several institutions have supplied long series. We are now in exchange relations with over one hundred and fifty institutions and departments.

One result of these numerous accessions has been a severe pressure on the Library accommodation. More space was imperative, and since an extension of the building was financially out of the question immediate needs were met by rearrangements of shelving and a measure of decentralization. Plant Pathological and Entomological literature has been transferred to the charge of the officers concerned. Another result has been large bookbinding requirements, three natives being employed continuously on this work.

More than half the total expenditure of the Library during the year went in the purchase of periodicals and the expenses of binding. With the approval of the Secretary of State for the Colonies a contribution was made towards the publication of the book *Migration of Butterflies* (Biological Monographs Series) by the late Entomologist at the Research Station, Mr. C. B. Williams. Books, as distinct from periodicals, obtained during the year numbered only fifty-six.

The rearrangement of the Library in accordance with the new classification has been completed. Some progress has been made

with the classified subject index, but the scientific officers have been able to spare little time from their laboratory work to deal with their specialist literature. Increasing use is being made of the facilities offered by the East African Agricultural Research Station Library in respect of loans of literature to scientific workers in the contributing territories.

R. E. Moreau.

Secretary and Librarian.

APPENDIX.

FINANCIAL SUMMARY.

Position of the East African Agricultural Research Station.
Maintenance Account as at 31st March, 1931.*

Revenue to 31st March, 1931.

	£	£
Total contributed by Governments and Empire Marketing Board†		65,909
(Present annual rates of contributions are :—		
Tanganyika	6,000	
Kenya	1,700	
Uganda	1,800	
Zanzibar	1,200	
Northern Rhodesia	300	
Nyasaland	300	
Empire Marketing Board	6,000)	
Amani Local Revenue		5,549
GRAND TOTAL ...		£71,458

Expenditure to 31st March, 1931.

On Maintenance (from Table A below)	67,510	
Transferred to Capital Account (Table B) ...	4,980	
		72,490
Debit Balance as at 31st March, 1931		£1,032‡

TABLE A.

Maintenance Expenditure.

HEAD.	1927–28. £	1928–29. £	1929–30. £	1930–31. £
Personal Emoluments—				
Pay	3,862	8,179	8,879	9,931
Pensions Contributions	—	2,022	1,281	1,347
Passages	541	635	638	839
Other Charges—				
Laboratories	66	998	1,219	800
Library	248	432	446	500
Office and Contingencies	93	395	218	222
Labour	1,854	1,140	2,612	1,319
Materials	157	357	887	550
Freight and Transport	832	1,353	1,078	642
Travelling	305	884	620	606
Kwamkoro	198	2,227	2,468	2,355
Total	8,156	18,622	20,346	19,111

1929–30	20,346
1928–29	18,622
1927–28	8,156
1926–27 (not itemized) ...	1,275
Total Maintenance Expenditure to 31st March, 1931	£67,510

* Subject to final reconciliation on the closing of the 1930–31 accounts. Only minor adjustments between financial years are, however, expected.

† Credit taken for all contributions due for the period whether actually paid or not.

‡ This is due to the net expense of working Kwamkoro Estate during 1930–31, which amounted to £1,101. It has been arranged to take up a loan to cover this, and the Maintenance Account will be re-imbursed correspondingly.

TABLE B.

Capital Account.

REVENUE—	£
Contributed by Tanganyika Territory	10,250
„ „ Kenya	4,100
„ „ Uganda	2,460
„ „ Zanzibar	1,640
„ „ Nyasaland	1,025
„ „ Northern Rhodesia	1,025
„ „ Colonial Research Committee	2,000
	£22,500

N.B.—A sum of £2,000 has recently been received from the Carnegie Fund for the specific purposes of the Library.

EXPENDITURE—	£	
Housing and Furniture	6,553	
Laboratories	4,199	
Electricity, Gas, and Water	3,289	
Alterations and Repairs	2,351	
Greenhouses	500	
Workshop, Fire, and Office Equipment	765	
Roads	2,203	
Motor Vehicles	1,880	
Freight and Erection	1,040	
Kwamkoro*	4,700	
	27,480	
Excess, met from Maintenance Account	4,980	
		£22,500

* It was originally intended to finance this capital item by means of a loan but, as accumulated balances were in hand on the maintenance account at the time the estate was taken over, instructions were received to draw upon that source in order to save interest charges.

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EMPIRE MARKETING BOARD PUBLICATIONS.

Note on the work of the Board and Statement of Research and other Grants approved by the Secretary of State from July, 1926, to March, 1930. Cmd. 3637. 6*d.* (7*d.*).

Agricultural Economics in the Empire. (E.M.B. 1.) 6*d.* (7*d.*).

Tropical Agricultural Research in the Empire, with special reference to Cacao, Sugar Cane, Cotton and Palms. (E.M.B. 2.) 1*s.* 6*d.* (1*s.* 9*d.*).

Geophysical Surveying. Report of Sub-Committee of the Committee of Civil Research. November 1927 (E.M.B. 6.) 6*d.* (7*d.*).

The Chemistry of Wine Making. A Report on Oenological Research. (E.M.B. 7. 1*s.* 0*d.* (1*s.* 2*d.*).

Grass and Fodder Crop Conservation in Transportable Form. (E.M.B. 8.) 1*s.* 0*d.* (1*s.* 2*d.*).

Empire Grown Sisal and its importance to the Cordage Manufacturer. (E.M.B. 10.) 6*d.* (8*d.*).

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Report on Insect Infestation of Dried Fruit. (E.M.B. 12.) 1*s.* 0*d.* (1*s.* 2*d.*).

Grapefruit Culture in the British West Indies and British Honduras (E.M.B. 13.) 1*s.* 0*d.* (1*s.* 2*d.*).

Survey Method of Research in Farm Economics. January, 1929. (E.M.B. 14.) 6*d.* (8*d.*).

Oranges. World Production and Trade, Memorandum prepared in the Statistics and Intelligence Branch. April, 1929. (E.M.B. 15.) 1*s.* 0*d.* (1*s.* 3*d.*).

Schistosomiasis and Malaria in Relation to Irrigation. May, 1929. (E.M.B. 17.) 1*s.* 3*d.* (1*s.* 5*d.*).

Composition of Pastures. June, 1929. (E.M.B. 18.) 9*d.* (11*d.*).

Panama Disease of Bananas. Reports on scientific visits to the Banana growing countries of the West Indies, Central and South America. July 1929. (E.M.B. 20.) 1*s.* 6*d.* (1*s.* 10*d.*).

Wool, a study of the fibre. September, 1929. (E.M.B. 21.) 1*s.* 6*d.* (1*s.* 11*d.*).

The Demand for Cheese in London. November, 1929. (E.M.B. 22.) 1*s.* 0*d.* (1*s.* 2*d.*).

The Growing Dependence of British Industry upon Empire Markets. December, 1929. (E.M.B. 23.) 1*s.* 0*d.* (1*s.* 1*d.*).

Insect Infestation of Stored Cacao. December, 1929. (E.M.B. 24.) 1*s.* 6*d.* (1*s.* 8*d.*).

Indian Sunn (or Sann) Hemp. Its Production and Utilization. February, 1930. (E.M.B. 25.) 1*s.* 0*d.* (1*s.* 1*d.*).

British Industries and Empire Markets. March, 1930. (E.M.B. 26.) 1*s.* 0*d.* (1*s.* 2*d.*).

Cocoa. World Production and Trade. May, 1930. (E.M.B. 27.) 1*s.* 0*d.* (1*s.* 3*d.*).

Empire Marketing Board. May, 1929 to May, 1930. June, 1930. (E.M.B. 28.) 1*s.* 0*d.* (1*s.* 3*d.*).

The Biological Control of Insect and Plant Pests. June, 1930. (E.M.B. 29.) 1*s.* 0*d.* (1*s.* 4*d.*).

Canadian Fruit Shipments. Report of an investigation into the Deterioration in Transit of Imported Canadian Fruit, 1927–29. June, 1930. (E.M.B. 30.) 1*s.* 0*d.* (1*s.* 2*d.*).

The Production of Tung Oil in the Empire. June, 1930. (E.M.B. 31.) 1*s.* 0*d.* (1*s.* 1*d.*)

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